NEW FEATURES

ENGINE

■ 1GR-FE ENGINE

1. General

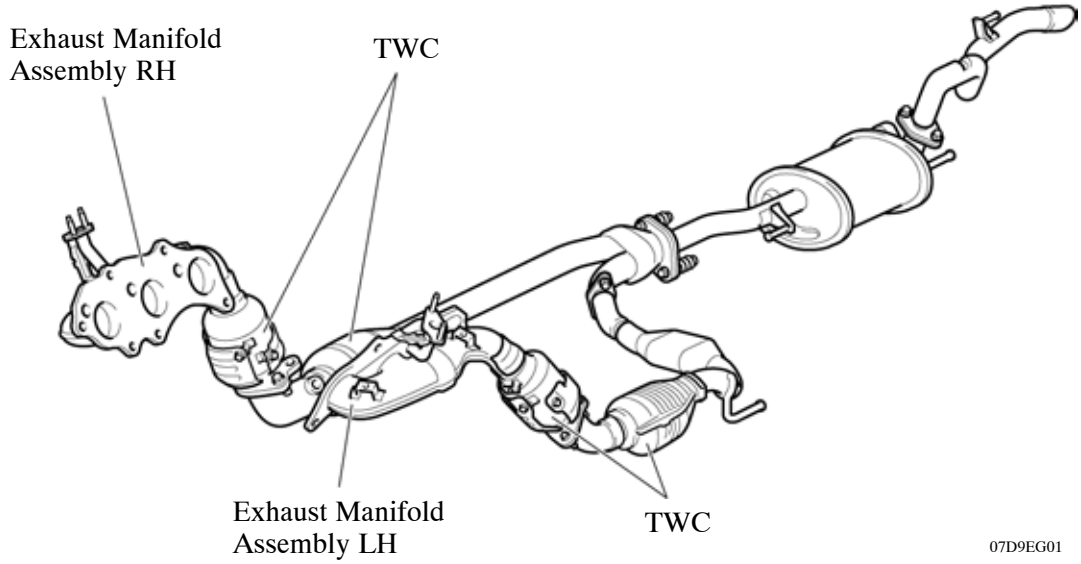
- By the adaptation of an air injection system along with the optimization of the characteristics of the three-way catalytic converters (TWC) attached to the exhaust manifold and exhaust pipe, 1GR-FE engine for Chile package models has been complied with EURO V regulations*.
- Along with the adaptation of an air injection system, the exhaust manifold for Chile package models has been changed to the one with air injection system air passage.
- The fuel pump control ECU for Chile package models has been changed to a linear control type that allows proper fuel controls according to the running conditions.

*: Chile package models use a Tier 2 – Bin 5 system for emission control.

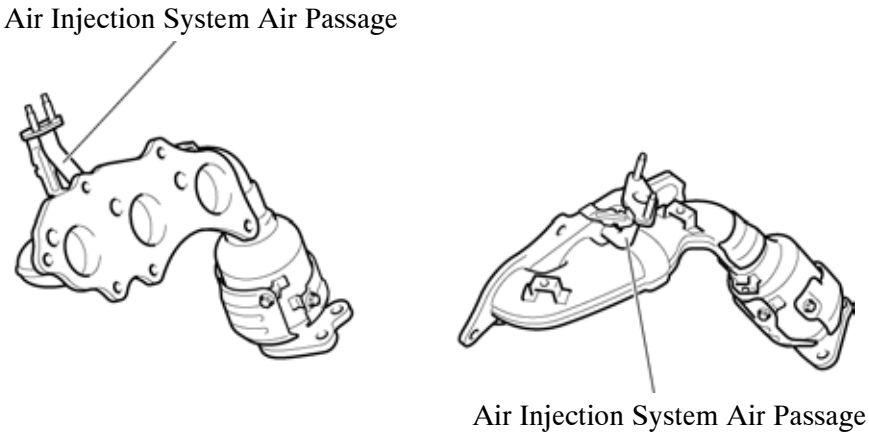
2. Intake and Exhaust System

- For the purpose that 1GR-FE engine for Chile package models is able to comply with EURO V regulations*, the catalyzer capacity, quantity of noble metals, and cell density of the three-way catalytic converters (TWC) attached to the exhaust manifold and exhaust pipe have been optimized to increase the efficiency.
- For Chile package models, the exhaust manifold with air injection system air passage for introducing air sent from the air pump assembly into it has been adopted.

*: Chile package models use a Tier 2 – Bin 5 system for emission control.



▶ Exhaust Manifold ◀



2300EG02

3. Engine Control System

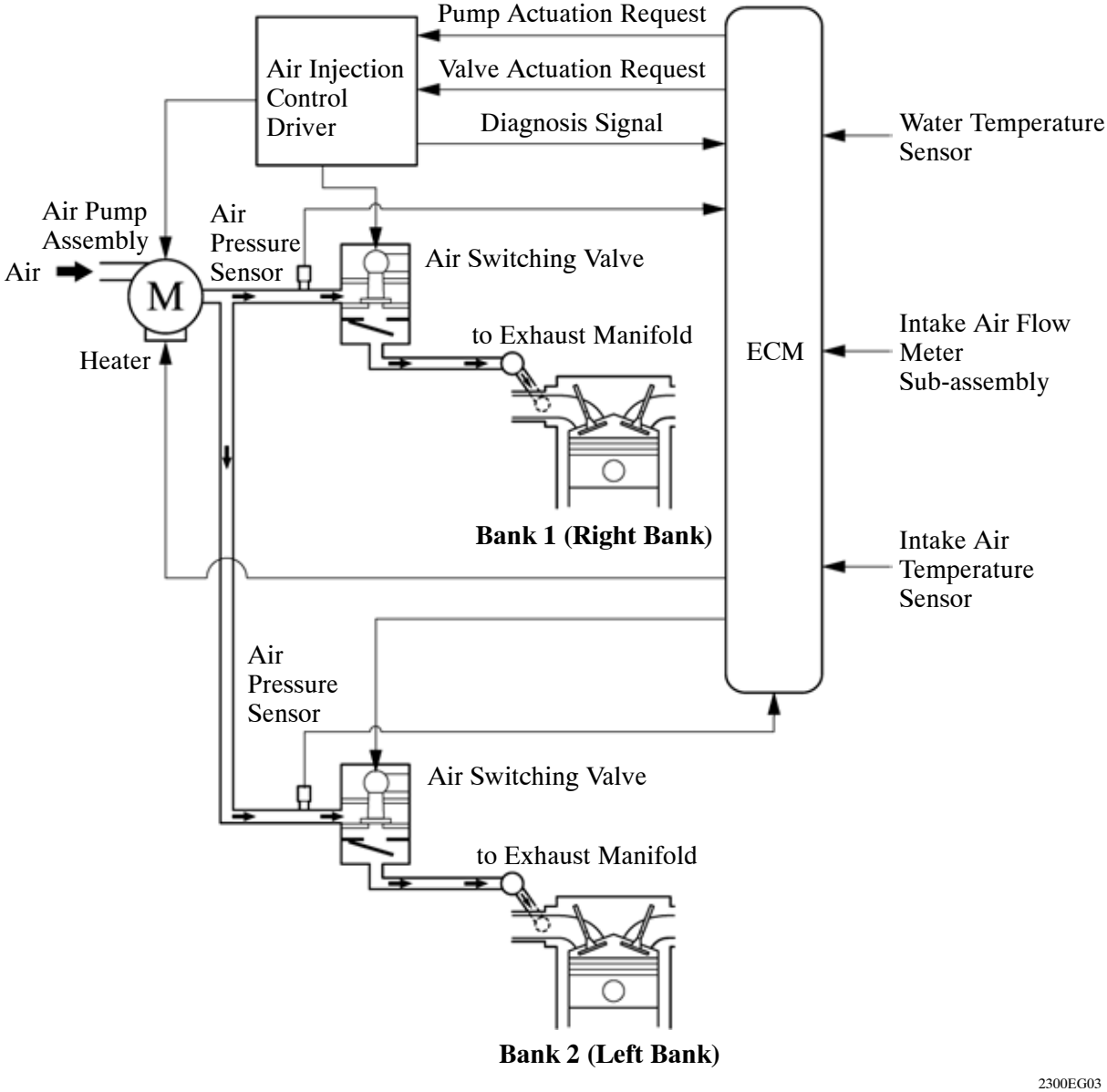
Air Injection System

1) General

An air injection system has been adopted for Chile package models in order to ensure appropriate heating ability for the three-way catalytic converters (TWCs) after cold-starting the engine.

- This system is comprised of an air injection control driver, an air pump assembly, and 2 air switching valves (emission control valve set) with built-in air pressure sensors.
- Air switching valves are installed on each bank, and are controlled by the air injection control driver on the right bank side (bank 1) and by the ECM on the left bank (bank 2).
- The ECM estimates the amount of air injected to the TWCs based on signals from the mass air flow meter in order to regulate the air injection time.

▶ System Diagram ◀



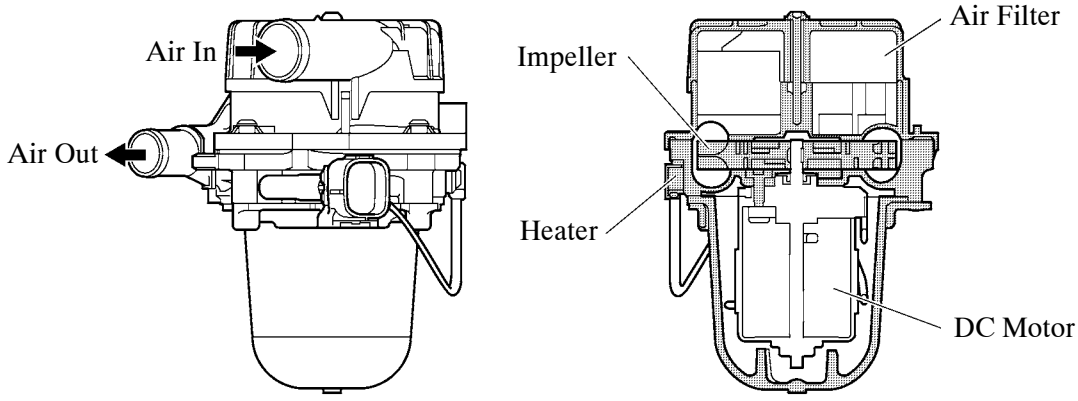
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2) Construction and Operation

a. Air Pump Assembly

The air pump assembly consists of a DC motor, an impeller, an air filter and heater.

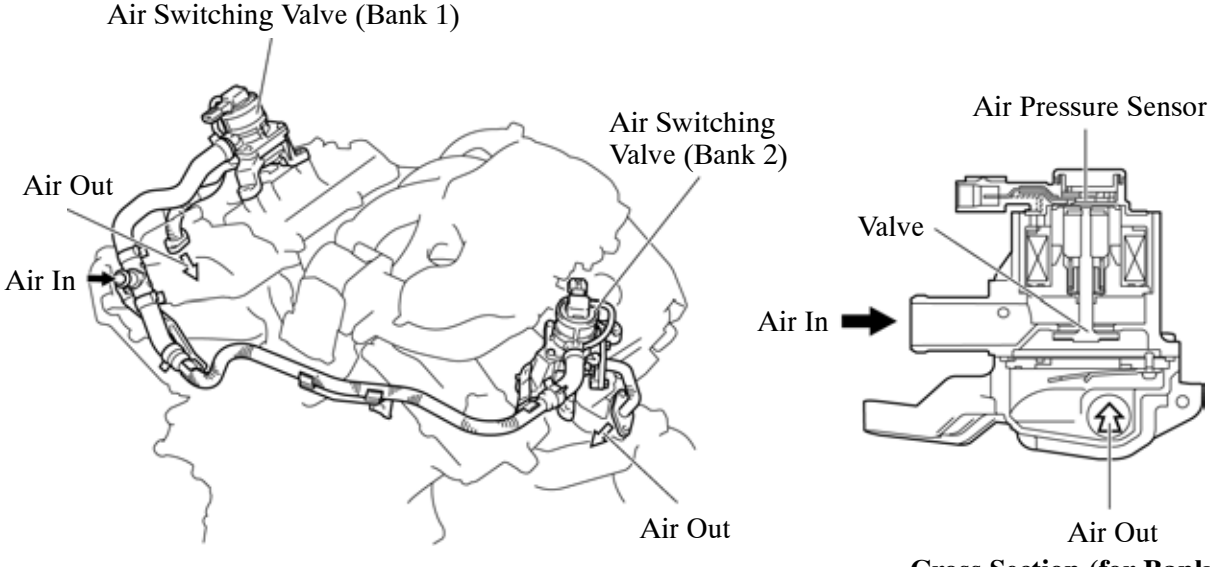
- The DC motor is controlled by the air injection control driver in accordance with signals from the ECM. The motor supplies air into an air switching valve through the impeller.
- The air filter is maintenance-free.
- A heater is provided to prevent operation faults in cold conditions.



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b. Air Switching Valve

- The air switching valves consist of a valve that switches the air flow and a reed valve that restricts the exhaust flow to one direction.
- The air switching valves are solenoid valves that are actuated by the ECM and air injection control driver.
- An air pressure sensor is built into the corresponding air switching valve.
- The air switching valves for bank 1 and bank 2 have the same basic structure and function.

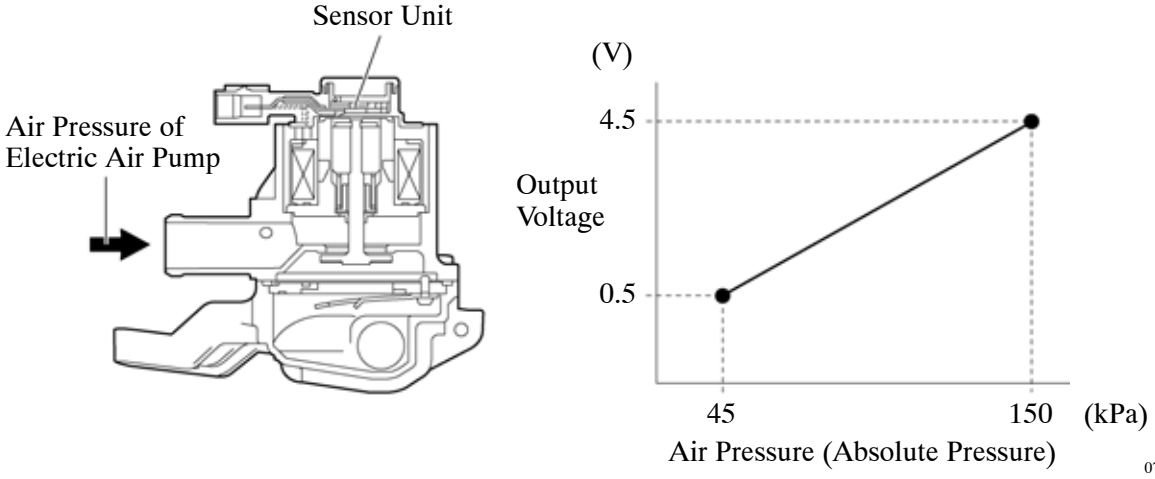


Cross Section (for Bank 1)

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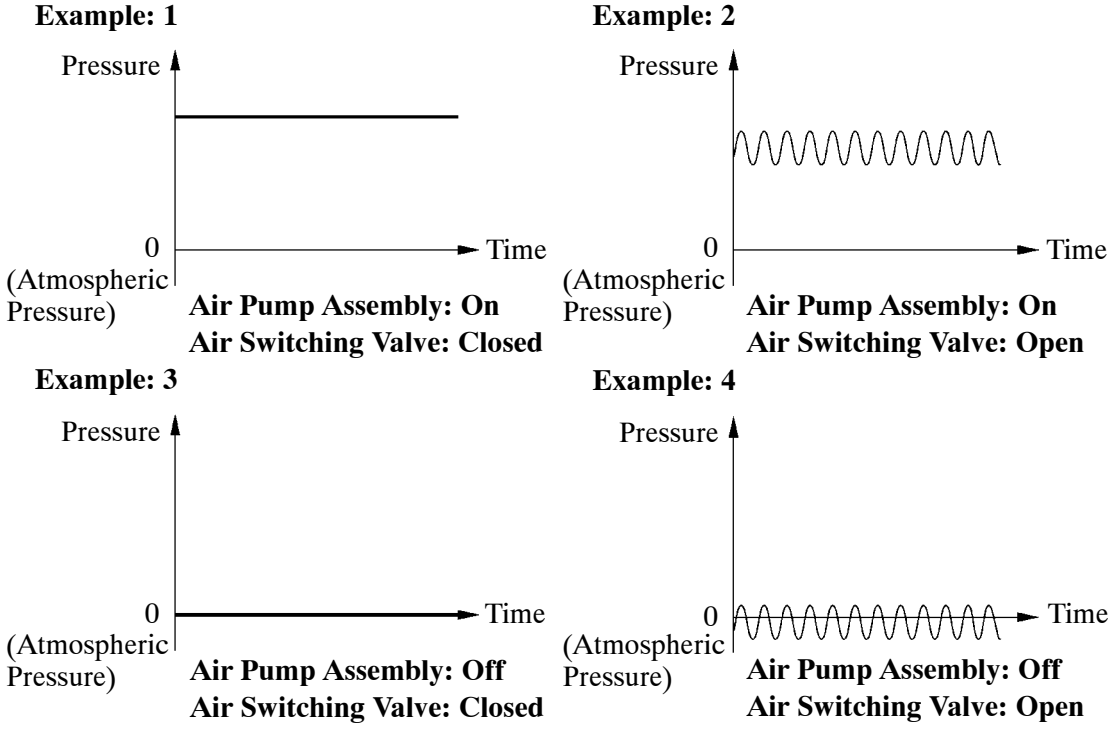
c. Air Pressure Sensor

- The air pressure sensor consists of a semiconductor, which has a silicon chip that changes its electrical resistance when pressure is applied to it. The sensor converts the pressure into an electrical signal, and sends it to the ECM in an amplified form.
- The air pressure sensors for bank 1 and bank 2 have the same basic structure and function.



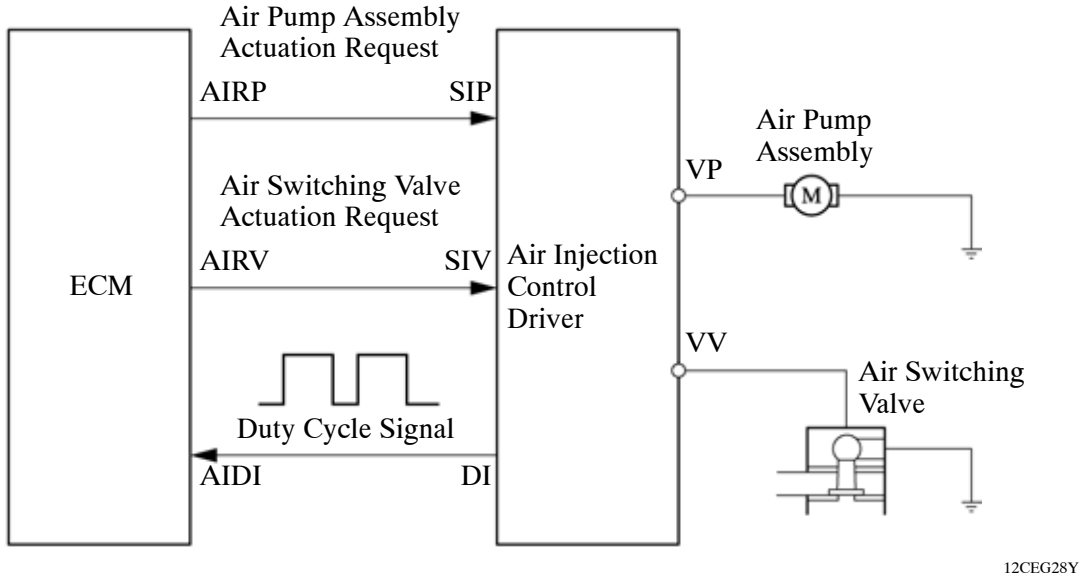
The ECM detects operation of the air injection system based on signals from the air pressure sensor as follows:

1) When the air pump assembly is on and the air switching valve is closed, the pressure is stable.
2) When the air pump assembly is on and the air switching valve is open, the pressure drops slightly and becomes unstable because of exhaust pulses.
3) When the air pump assembly is off and the air switching valve is closed, the pressure remains at atmospheric pressure.
4) When the air pump assembly is off and the air switching valve is open, the pressure drops below atmospheric pressure and becomes unstable because of exhaust pulses.



d. Air Injection Control Driver

- A semiconductor type air injection control driver is used. Activated by the ECM, this driver actuates the air pump assembly and the air switching valve.
- The air injection control driver also detects failures in the input and output circuits of the air injection control driver and transmits the failure status to the ECM via duty cycle signals.
- The following system chart shows bank 1 (right bank):



▶ DI Terminal Output ◀

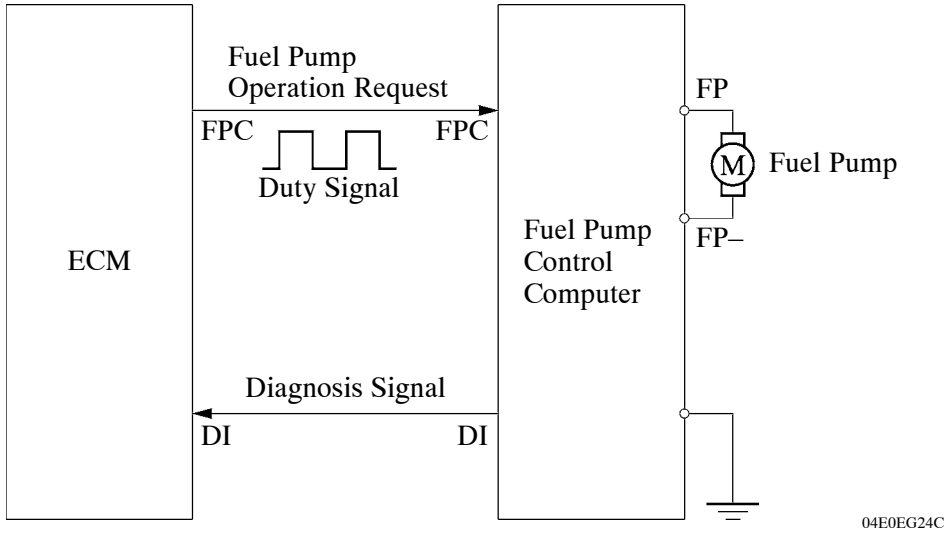
Condition	AIRP	AIRV	Output (Duty Cycle Signal)
Open circuit in line between AIDI and DI terminals.	—	—	GND 273GX28
Failure in line between ECM terminals and air injection control driver.	—	—	GND 273GX28
Output failure at air injection control driver (failure in air pump actuation circuit).	—	—	200 ms, Duty 20%, GND 273GX30
Output failure at air injection control driver (failure in air switching valve actuation circuit).	—	—	Duty 40%, GND 273GX31
Overheat failure of air injection control driver.	—	—	Duty 60%, GND 273GX32
Normal	On	On	Duty 80%, GND 273GX33
	Off	Off	GND 273GX29
	On	Off	
	Off	On	

Fuel Pump Control

1) General

- The fuel pump control ECU for Chile package models has been changed to a linear control type that allows proper fuel controls according to the running conditions.
- A fuel pump featured with lower power consumption, reduced fuel pump operating noise, and longer life has been provided, as it has become possible to operate the fuel pump at lower speeds if fuel consumption is low, by the adaptation of a linear type fuel pump control ECU.
- In addition to when the engine is stopped, the fuel pump is stopped when the airbags are deployed to reduce fuel leakage to minimum.

▶ System Diagram ◀



2) Fuel Pump Control ECU

- In the fuel pump speed control, the ECM transmits fuel pump operation request signals in accordance with the engine operating conditions. In response to the request signals, the fuel pump ECU then transmits linear output signals to the fuel pump, optimally regulating the fuel pump speed.
- In the fuel pump cut control, if the ECM receives airbag deployment signals from the center airbag sensor assembly, it transmits stop signals to the fuel pump control ECU to bring the fuel pump to a halt. When receiving a stop signal, the fuel pump control ECU stops the fuel pump.

▶ FP Terminal Output Voltage ◀

Condition		FP Terminal
Normal	Duty input from the ECM: 25% to 80%	Linear
	Duty input from the ECM: 0% or 100% (Included when the airbag is deployed.)	Off
Self-protection function is activated due to overcurrent or overheating.		Off
Open circuit is detected in the FPC signal line connected to the ECM.		Off